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(71) Applicant: **HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.** [US/US]; 10300 Energy Drive, Spring, Texas 77389 (US).

(72) Inventors: **HOLSTUN, Clayton L.**; 16399 W Bernardo Dr., San Diego, California 92127-1899 (US). **GARDNER, James Michael**; 1070 NE Circle Boulevard, Corvallis, Oregon 97330-4239 (US). **MARTIN, Eric T.**; 1070 NE Circle Blvd., Corvallis, Oregon 97330-4239 (US).

(74) Agent: **HOOPES, Benjamin** et al.; HP Inc., Mail Stop 35 3390 E. Harmony Road, Fort Collins, Colorado 80528 (US).

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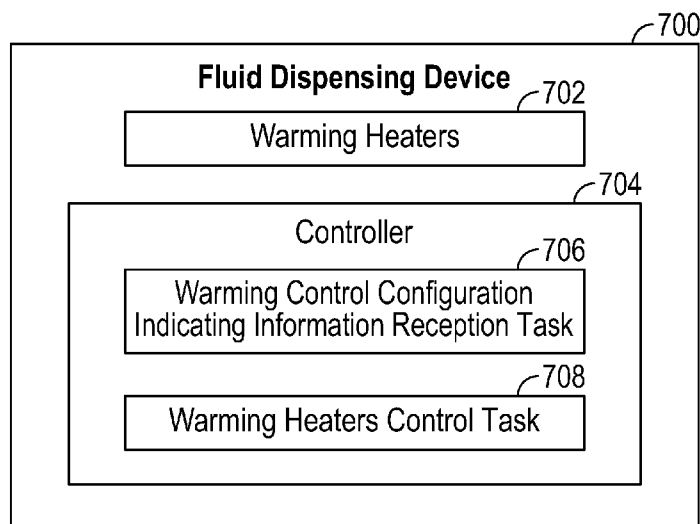


FIG. 7

(57) Abstract: In some examples, a fluid dispensing device includes warming heaters and a controller. The controller receives first information based on a first fluid dispensing pattern for the fluid dispensing device, the first information indicating a first warming control configuration to apply based on fluid dispensing regions with different operational characteristics corresponding to the first fluid dispensing pattern, where the first warming control configuration is selected from different warming control configurations that correspond to different fluid dispensing patterns having respective different arrangements of fluid dispensing regions with different operational characteristics. The controller controls the warming heaters according to the first warming control configuration.

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## WARMING HEATER CONTROL FOR FLUID DISPENSING DEVICES

### Background

[0001] A fluid dispensing system can dispense fluid towards a target. In some examples, a fluid dispensing system can include a printing system, such as a two-dimensional (2D) printing system or a three-dimensional (3D) printing system. A printing system can include printhead devices that include fluidic actuators to cause dispensing of printing fluids.

### Brief Description of the Drawings

[0002] Some implementations of the present disclosure are described with respect to the following figures.

[0003] Fig. 1 is a block diagram of a fluid dispensing system according to some examples.

[0004] Figs. 2-4 are block diagrams of different configurations of a fluid dispensing device including thermal sensors and end warming heaters, according to some examples.

[0005] Fig. 5 is a block diagram of another fluid dispensing device including thermal sensors, end warming heaters, and additional warming heaters, according to further examples.

[0006] Fig. 6 is a block diagram of a fluid dispensing device including multiple zones that can be individually temperature-controlled, according to some examples.

[0007] Fig. 7 is a block diagram of a fluid dispensing device according to further examples.

[0008] Fig. 8 is a block diagram of a system according to some examples.

[0009] Fig. 9 is a block diagram of a storage medium storing machine-readable instructions according to some examples.

[0010] Throughout the drawings, identical reference numbers designate similar, but not necessarily identical, elements. The figures are not necessarily to scale, and the size of some parts may be exaggerated to more clearly illustrate the example shown. Moreover, the drawings provide examples and/or implementations consistent with the description; however, the description is not limited to the examples and/or implementations provided in the drawings.

#### Detailed Description

[0011] In the present disclosure, use of the term "a," "an," or "the" is intended to include the plural forms as well, unless the context clearly indicates otherwise. Also, the term "includes," "including," "comprises," "comprising," "have," or "having" when used in this disclosure specifies the presence of the stated elements, but do not preclude the presence or addition of other elements.

[0012] A fluid dispensing device can include fluidic actuators that when activated cause dispensing (e.g., ejection or other flow) of a fluid. For example, the dispensing of the fluid can include ejection of fluid droplets by activated fluidic actuators from respective nozzles of the fluid dispensing device. In other examples, an activated fluidic actuator (such as a pump) can cause fluid to flow through a fluid conduit or fluid chamber. Activating a fluidic actuator to dispense fluid can thus refer to activating the fluidic actuator to eject fluid from a nozzle or activating the fluidic actuator to cause a flow of fluid through a flow structure, such as a flow conduit, a fluid chamber, and so forth.

[0013] In some examples, the fluidic actuators include thermal-based fluidic actuators including heating elements, such as resistive heaters. When a heating element is activated, the heating element produces heat that can cause vaporization of a fluid to cause nucleation of a vapor bubble (e.g., a steam bubble) proximate the thermal-based fluidic actuator that in turn causes dispensing of a quantity of fluid, such as ejection from an orifice of a nozzle or flow through a fluid conduit or fluid

chamber. In other examples, a fluidic actuator may be a piezoelectric membrane based fluidic actuator that when activated applies a mechanical force to dispense a quantity of fluid.

[0014] In examples where a fluid dispensing device includes nozzles, each nozzle includes a fluid chamber, also referred to as a firing chamber. In addition, a nozzle can include an orifice through which fluid is dispensed, a fluidic actuator, and possibly a sensor. Each fluid chamber provides the fluid to be dispensed by the respective nozzle. In other examples, a fluid dispensing device can include a microfluidic pump that has a fluid chamber.

[0015] Generally, a fluidic actuator can be an ejecting-type fluidic actuator to cause ejection of a fluid, such as through an orifice of a nozzle, or a non-ejecting-type fluidic actuator to cause displacement of a fluid.

[0016] In some examples, a fluid dispensing device can be in the form of a fluidic die or an arrangement of fluidic dies. A “die” refers to an assembly where various layers are formed onto a substrate to fabricate circuitry, fluid chambers, and fluid conduits. A fluidic die (or multiple fluidic dies) can be mounted or attached to a support structure. In further examples, a fluidic die, or multiple fluidic dies, may be molded into a monolithic molding structure.

[0017] In some examples, a fluidic die can include a printhead die, which can be mounted to a print cartridge, a carriage assembly, and so forth. A printhead die includes nozzles through which a printing fluid (e.g., an ink, a liquid agent used in a 3D printing system, etc.) can be dispensed towards a target (e.g., a print medium such as a paper sheet, a transparency foil, a fabric, etc., or a print bed including 3D parts being formed by a 3D printing system to build a 3D object).

[0018] The temperature of a fluid dispensing device, such as a fluidic die, is regulated to achieve better performance of the fluid dispensing device. A variation in temperature across the fluid dispensing device outside a target temperature range may cause thermal gradients that can lead to sub-optimal performance of the fluid

dispensing device. For example, if the fluid dispensing device is a printhead, then a temperature variation across the printhead may lead to a visible impact on the print quality.

[0019] Depending on a fluid dispensing pattern of the fluid dispensing device, certain parts of the fluid dispensing device can be warmer while other parts of the fluid dispensing device can be cooler. With a printhead (e.g., a printhead die), for example, print data may cause a first part of the printhead to deliver a higher print density of printing fluid than a second part of the printhead. Fluidic actuators in the first part of the printhead may be more heavily used to eject more printing fluid droplets, while fluidic actuators in the second part may be more lightly used, and sometimes, may even be inactive (i.e., the fluidic actuators in the second part are not activated). In this example, the first part of the printhead can become much hotter than the second part of the printhead during use of the printhead.

[0020] A printing system can support a number of print modes. A "print mode" can refer to a strategy of printing that employs selected part(s) of a printhead during a printing operation. The selected part(s) of the printhead can include the entire printhead (i.e., all of the nozzles of the printhead are used), or the selected part(s) of the printhead can use just a subset of the nozzles of the printhead (e.g., the subset of the nozzles in a first half or second half of the printhead).

[0021] Print modes that employ just a subset of the nozzles of the printhead employ partial printhead printing. With partial printhead printing, a partial portion of the printhead is active (i.e., fluidic actuators in this partial portion can be activated to dispense fluid depending upon the input print data), while the remaining portion remains inactive during printing.

[0022] In other examples, rather than selecting which part(s) of the printhead is (are) active and which part(s) of the printhead is (are) inactive, a print operation may cause different densities of printing fluid to be dispensed by respective different parts of the printhead. For example, the printhead may dispense the printing fluid in a first part at a first print density, and the printhead may dispense the printing fluid in a

second part at a second print density. Such a print operation may be referred to as "ramp mask printing" in some examples, where ramp mask printing uses different printing fluid densities in different swaths.

[0023] Although reference is made to different print modes or print operations in the foregoing examples, it is noted that more generally, different fluid dispensing patterns may be employed for an operation of a fluid dispensing device. A fluid dispensing pattern indicates which part(s) of the fluid dispensing device is (are) associated with a larger amount of fluid dispensing, and which other part(s) of the fluid dispensing device is (are) associated with a smaller amount of fluid dispensing. The "smaller amount" of fluid dispensing can refer to zero fluid dispensing or a non-zero amount of fluid dispensing that is less than the fluid dispensing used in the part(s) associated with the large amount of fluid dispensing.

[0024] Even more generally, a fluid dispensing pattern indicates that different parts of the fluid dispensing device have different operational characteristics. Examples of operational characteristics include any or some combination of: a fluid dispensing density (e.g., spatial density of fluid droplets in a given area or volume), a drop weight (which refers to a volume of a fluid drop dispensed by a nozzle orifice), a fluidic actuator activation frequency (which refers to how frequently a fluidic actuator is activated), a net fluid flux (which refers to a rate of fluid flow across a unit area), and so forth.

[0025] In accordance with some implementations of the present disclosure, as shown in Fig. 1, a fluid dispensing device 102 (e.g., including a fluidic die or multiple fluidic dies) that can be mounted in a fluid dispensing system 100 includes warming heaters 104, which can be heaters separate from fluidic actuators 106 of the fluid dispensing device 102, or alternatively, can include heating elements, such as resistive heaters, of the fluidic actuators 106.

[0026] The fluid dispensing device 102 further includes a device controller 108 to perform various tasks of the fluid dispensing device 102, such as in response to

information received from an external system controller 110 (e.g., a print controller of a printing system), or in response to other events.

[0027] As used here, a "controller" can refer to a hardware processing circuit, which can include any or some combination of a microprocessor, a core of a multi-core microprocessor, a microcontroller, a programmable integrated circuit, a programmable gate array, an integrated circuit logic, or another hardware processing circuit. Alternatively, a "controller" can refer to a combination of a hardware processing circuit and machine-readable instructions (software and/or firmware) executable on the hardware processing circuit.

[0028] The device controller 108 receives configuration information 112 based on a fluid dispensing pattern for the fluid dispensing device 102, where the configuration information 112 indicates a warming control configuration to apply based on fluid dispensing regions with different operational characteristics in the fluid dispensing device 102.

[0029] In some examples, the system controller 110 provides the configuration information 112 to the device controller 108. A communications path (formed of an electrical link such as an electrical cable, for example) can be provided between the system controller 110 and a support 114 to which the fluid dispensing device 102 is mounted. The fluid dispensing device 102 can be fixedly or removably mounted to the support 114. In some examples, the support 114 can include any of a moveable carriage, a print cartridge, a print bar, and so forth. A further communication path (such as in the form of electrical traces) can extend between the support 114 and the device controller 108 in the fluid dispensing device 102.

[0030] The system controller 110 includes warming control configuration selection logic 111, which can be implemented as a part of the hardware processing circuit of the system controller 110, or as machine-readable instructions executable by the hardware processing circuit of the system controller 110.

[0031] The warming control configuration selection logic 111 can select a warming control configuration from different warming control configurations that correspond to different fluid dispensing patterns having respective different arrangements of fluid dispensing regions with different operational characteristics. For example, if an operational characteristic of the fluid dispensing device 102 is fluid dispensing density, then the system controller 110 can select the warming control configuration to apply based on fluid densities to be provided by different regions of the fluid dispensing device 102.

[0032] For example, a first region of the fluid dispensing device 102 can dispense fluid at a first fluid dispensing density (e.g., zero fluid dispensing density or a low fluid dispensing density), while a second region of the fluid dispensing device 102 can dispense fluid at a second fluid dispensing density that is greater than the first fluid dispensing density. The warming control configuration selected can then be based on where the first and second regions are located, and the relative extents of the first and second regions across the fluid dispensing device 102.

[0033] Although some examples are described in the context of different fluid densities provided by different regions of the fluid dispensing device 102, similar techniques can be applied for other types of operational characteristics of the fluid dispensing device 102.

[0034] Information regarding the different warming control configurations 130 can be stored in a storage medium 132 in the fluid dispensing system 100. The storage medium 132 can be implemented using a memory device (or multiple memory devices) and/or a storage device (or multiple storage devices).

[0035] The device controller 108 controls the warming heaters 104 according to the indicated warming control configuration (as indicated by the configuration information 112). The configuration information 112 can include an identifier of a respective warming control configuration. For example, the different warming control configurations 130 may be identified by respective different identifiers. An identifier

can be in the form of an index, a number, a label, or any other information that can distinguish between the different warming control configurations 130.

[0036] In response to the configuration information 112, operational characteristic based warming control logic 109 in the device controller 108 can control the warming heaters 104 according to the warming control configuration indicated by the configuration information 112. The operational characteristic based warming control logic 109 can be implemented as a part of the hardware processing circuit of the device controller 108, or as machine-readable instructions executable by the hardware processing circuit of the device controller 108.

[0037] In some examples, the warming control configuration can specify which subset of thermal sensors in the fluid dispensing device 102 to use for controlling end warming heaters (end warming is discussed further below). The different warming control configurations 130 can cause the operational characteristic based warming control logic 109 to select of different subsets of thermal sensors to use for end warming control.

[0038] In alternative examples, the warming control configuration can control warming to be applied to different zones of the fluid dispensing device 102 for fine grain thermal control depending upon different operational characteristics in the different zones of the fluid dispensing device 102 (fine grain control is also discussed further below). The operational characteristic based warming control logic 109 can configure individual warming control of the zones of the fluid dispensing device 102 based on the warming control configuration indicated by the configuration information 112.

[0039] In some examples, the fluid dispensing system 100 can be a printing system, such as a 2D printing system or a 3D printing system. In other examples, the fluid dispensing system 100 can be a different type of fluid dispensing system. Examples of other types of fluid dispensing systems include those used in fluid sensing systems, medical systems, vehicles, fluid flow control systems, and so forth.

[0040] In some examples, the fluid dispensing device 102 includes nozzles 116 that have orifices through which fluid can be dispensed to a target medium 118 (e.g., a print medium) in response to activation of respective fluidic actuators 106. In a 2D printing system, the target medium 118 can include a paper, a fabric, a transparency foil, and so forth. In a 3D printing system, the target medium 118 can include a build bed including a 3D part (or multiple 3D parts) of a 3D object built by the 3D printing system on a layer-by-layer basis.

[0041] As the fluid dispensing device 102 and the target medium 118 are moved relative to one another (due to movement of the support 114 and/or the target medium 118), selected fluidic actuators 106 can be activated to cause dispensing of fluid droplets from respective orifices of the nozzles 116 onto target portions of the target medium 118.

[0042] The foregoing examples refer to ejecting-type fluidic actuators 106 to cause ejection of a fluid through respective orifices of the nozzles 116. In other examples, non-ejecting-type fluidic actuators 106 can cause displacement of a fluid. For example, the non-ejecting-type fluidic actuators 106 can include pumps to cause movement of fluid inside the fluid dispensing device 102.

[0043] In some examples, the fluidic actuators 106 can include heating elements such as electrically resistive heaters. In other examples, the fluidic actuators 106 can include piezoelectric membrane based fluidic actuators that when activated applies a mechanical force to dispense quantities of fluid.

[0044] In some examples, the system controller 110 can control the operation of the fluid dispensing system 100 based on input data 120, which can be received from a computer (not shown) that is directly connected to the fluid dispensing system 100 or connected over a network to the fluid dispensing system 100. For example, the input data 120 can include print data representing text and/or images to be printed onto the target medium 118, or a digital representation of a 3D object to be built.

[0045] The input data 120 can indicate a fluid dispensing pattern to be applied by the fluid dispensing device 102. A fluid dispensing pattern indicates operational characteristics (e.g., fluid dispensing densities, drop weights, fluidic actuator activation frequencies, net fluid fluxes, etc.) for different regions of the fluid dispensing device 102. If the fluid dispensing system 100 is a printing system, then different fluid dispensing patterns can correspond to different print modes or other operational modes.

[0046] Note that the system controller 110 may receive further input information 121. If the fluid dispensing system 100 is a printing system, then the further input information 121 can include an indicator of a print mode that has been selected, such as by a user, a program, a machine, or another entity. In examples where the further input information 121 is provided to the system controller 110, the fluid dispensing pattern is based on the input data 120 and the further input information 121.

[0047] Based on the operational characteristics of the fluid dispensing pattern indicated by the input data 120 (and possibly the further input information 121), the warming control configuration selection logic 111 in the system controller 110 can produce the configuration information 112 that indicates a specific warming control configuration to apply, as selected by the warming control configuration selection logic 111 from the different warming control configurations 130.

[0048] The selection of a warming control configuration from among the different warming control configurations 130 can be based on correlation information that correlates different fluid dispensing patterns to the respective warming control configurations 130. Upon receiving the input data 120 (and possibly the further input information 121), the warming control configuration selection logic 111 can derive the fluid dispensing pattern that is to be applied, and can access the correlation information to identify which of the different warming control configurations 130 is to be selected.

[0049] Fig. 2 is a block diagram of a fluid dispensing device 202, which can be an example of the fluid dispensing device 102 of Fig. 1. The fluid dispensing device 202 includes several columns 204 of fluidic actuators, such as the fluidic actuators 106 of Fig. 1. In addition, fluid slots 206 supply fluid to the respective fluidic actuators in the columns 204.

[0050] Although a specific number of columns 204 of fluidic actuators and fluid slots 206 are shown in Fig. 2, it is noted that in other examples, a different number (1 or greater than 1) of columns 204 of fluidic actuators and a different number (1 or greater than 1) of fluid slots 206 can be used.

[0051] The fluid dispensing device 202 also includes a series of thermal sensors 208-1, 208-2, 208-3, 208-4, and 208-5, which can be thermal point sensors. A "thermal point sensor" is used to measure a temperature at a specific local region of the fluid dispensing device 202. For example, the thermal point sensor can be a diode sensor that uses a diode for measuring a temperature. A voltage drop across the terminals of the diode while conducting a specified electrical current varies depending on the temperature of the diode—this voltage drop can be measured and used as an indication of temperature. In other examples, other types of thermal point sensors can be employed.

[0052] The different thermal sensors 208-1, 208-2, 208-3, 208-4, and 208-5 may measure different temperatures in respective local regions of the fluid dispensing device 202.

[0053] In some examples, the series of thermal sensors 208-1 to 208-5 are arranged along a line that is at a center of the fluid dispensing device 202. The series of thermal sensors 208-1 to 208-5 extend along a direction that is generally parallel to a lengthwise axis of each of the columns 204 of fluidic actuators. In other examples, the series of thermal sensors 208-1 to 208-5 can be arranged in another location of the fluid dispensing device 202.

[0054] Although five thermal sensors are shown in Fig. 2, it is noted that a different example can employ a smaller number of thermal sensors or a larger number of thermal sensors.

[0055] The fluid dispensing device 202 further includes a first end portion 210-1 and a second end portion 210-2. The first end portion 210-1 is adjacent a first end 212-1 of the fluid dispensing device 202, and is closest to a first end of the columns 204 of fluidic actuators.

[0056] The second end portion 210-2 is adjacent a second end 212-2 of the fluid dispensing device 202, and is closest to a second end of the columns 204 of fluidic actuators.

[0057] The series of thermal sensors 208-1 to 208-5 extend from the first end portion 210-1 to the second end portion 210-2.

[0058] The first end portion 210-1 includes a first set of end warming heaters 214-1, and the second end portion 210-2 includes a second set of end warming heaters 214-2.

[0059] An end warming heater 214-1 or 214-2 can be implemented as an electrical resistive heater, for example. The end warming heaters 214-1 and 214-2 are separate from the fluidic actuators in the columns 204 of fluidic actuators.

[0060] The end warming heaters 214-1 and 214-2 can perform independent warming of the fluid dispensing device 202 according to an end warming technique. The control of the end warming heaters 214-1 and 214-2 is performed by the device controller 108 (Fig. 1) of the fluid dispensing device 202.

[0061] End warming performed by the end warming heaters 214-1 and 214-2 can be used to compensate for colder regions in the end portions 210-1 and 210-2 of the fluid dispensing device 202 due to lack of fluidic actuators in the end portions of 210-1 and 210-2. Since the end portions 210-1 and 210-2 also have a relatively large thermal mass, the end portions 210-1 and 210-2 can also cause the fluid in the ends

of the columns 204 of fluidic actuators to be colder, which can adversely affect fluid dispensing performance by the fluidic actuators at the ends of the columns 204.

[0062] The end warming technique applied by the device controller 108 compensates for the temperature non-uniformity by activating and deactivating the end warming heaters 214-1 and 214-2 based on temperature measurements provided by the thermal sensors 208-1 to 208-5.

[0063] In accordance with some implementations of the present disclosure, the operational characteristic based warming control logic 109 of the device controller 108 (Fig. 1) can select a configuration of the thermal sensors 208-1 to 208-5 to use based on the configuration information 112 received from the system controller 110. As noted above, the configuration information 112 indicates a warming control configuration to apply.

[0064] According to the end warming technique, an end warming heater 214-1 or 214-2 is activated in response to a middle portion of the fluid dispensing device 202 becoming warmer (such as indicated by a temperature measured by the thermal sensor 208-3) than the respective end portion 210-1 or 210-2 of the fluid dispensing device 202. The difference in temperature between the middle portion and an end portion 210-1 or 210-2 can be based on temperature measurements taken by the thermal sensors 208-1 to 208-5. For example, if the thermal sensor 208-3 measures 58° Celsius (C) and the thermal sensor 208-1 measures 55° C, then the end warming heaters 214-1 in the end portion 210-1 are activated until the thermal sensors 208-1 and 208-3 indicate that the temperature difference has been neutralized (has reached a difference that is less than a specified threshold).

[0065] Similarly, the end warming heaters 214-2 are controlled by a difference between thermal sensors 208-3 and 208-5.

[0066] In further examples, the temperature of the middle portion of the fluid dispensing device 202 can be based on an aggregate (e.g., an average) of the temperatures measured by the middle thermal sensors 208-2, 208-3, and 208-4.

The difference between the aggregate temperature and an end temperature (as measured by the thermal sensor 208-1 or 208-5) can be used to selectively control activation of the respective end warming heaters 214-1 or 214-2.

[0067] The foregoing end warming technique assumes that an active fluid dispensing region covers all of the fluidic actuators of the fluid dispensing device 102; in other words, all of the fluidic actuators of the fluid dispensing device 102 are active and can be selectively activated based on input data specifying a fluid dispensing operation (e.g., print data).

[0068] Fig. 3 shows an example where about half of the fluidic actuators of the fluid dispensing device 202 are active (while the remaining fluidic actuators of the fluid dispensing device 202 are inactive). The active fluidic actuators are located in an active fluid dispensing region 302. Fluidic actuators outside of the active fluid dispensing region 302 are inactive.

[0069] In the example of Fig. 3, instead of using thermal sensors 208-1, 208-3, and 208-5, just the thermal sensors 208-1, 208-2, and 208-3 are employed (with the thermal sensors 208-4 and 208-5 not used) for controlling the end warming heaters 214-1 and 214-2. In the example arrangement of Fig. 3, the control of the end warming heaters 214-1 and 214-2 by the device controller 108 is based on temperature measurements from the thermal sensors 208-1, 208-2, and 208-3. The end warming heaters 214-1 are controlled based on a temperature difference detected by the thermal sensors 208-1 and 208-2, while the end warming heaters 214-2 are controlled based on a temperature difference detected by the thermal sensors 208-2 and 208-3.

[0070] Note that the use of thermal sensors 208-1, 208-3, and 208-5 when all of the fluidic actuators of the fluid dispensing device 202 are active can be considered a first warming control configuration of the fluid dispensing device 202. The arrangement shown in Fig. 3 where just the thermal sensors 208-1, 208-2, and 208-3 are used can be considered a second warming control configuration.

[0071] The selection of which thermal sensors to use based on the selected warming control configuration is performed by the operational characteristic based warming control logic 109 in the device controller 108 (Fig. 1).

[0072] Fig. 4 illustrates another example in which an active fluid dispensing region 402 encompasses about three quarters of the fluidic actuators in the columns 204 of the fluid dispensing device 202. Fluidic actuators in the active fluid dispensing region 402 are active, while fluidic actuators outside the active fluid dispensing region 402 are inactive.

[0073] For the arrangement of Fig. 4, a third warming control configuration is selected in which thermal sensors 208-1, 208-2, 208-3, and 208-4 are used for control of the end warming heaters 214-1 and 214-2. In the third warming control configuration, the thermal sensor 208-5 is not used. According to the third warming control configuration, the device controller 108 can control the end warming heaters 214-1 based on a temperature difference detected between the thermal sensor 208-1 and the thermal sensor 208-2, or alternatively, based on a temperature difference detected between the thermal sensor 208-1 and an aggregate temperature produced by aggregating (e.g., averaging) the temperatures measured by the thermal sensors 208-2 and 208-3.

[0074] The end warming heaters 214-2 are controlled based on a difference in temperature detected between the thermal sensor 208-4 and the thermal sensor 208-3, or alternatively, based on a difference in temperature detected between the thermal sensor 208-4 and an aggregate temperature produced from temperature measurements of the thermal sensors 208-2 and 208-3.

[0075] Other combinations of the thermal sensors 208-1 to 208-5 can be used for other end warming configurations.

[0076] Figs. 2-4 illustrate examples where end warming heaters 214-1 and 214-2 are provided at respective end portions 210-1 and 210-2 of the fluid dispensing

device 202. In further examples, as shown in Fig. 5, additional warming heaters can be provided in addition to the end warming heaters 214-1 and 214-2.

[0077] For example, a fluid dispensing device 502 as shown in Fig. 5 includes a first collection of additional warming heaters 504-1 and a second collection of additional warming heaters 504-2. The first collection of additional warming heaters 504-1 is closer to the end warming heaters 214-1 than the second collection of additional warming heaters 504-2. The second collection of additional warming heaters 504-2 is closer to the end warming heaters 214-2 than the first collection of additional warming heaters 504-1. The first and second collections of additional warming heaters 504-1, 504-2 are positioned at respective intermediate regions of the fluid dispensing device 502 between the end portions 210-1 and 210-2.

[0078] The first and second collections of additional warming heaters 504-1, 504-2 can be selectively controlled by the device controller 108 based on temperature measurements from selected thermal sensors 208-1 to 208-5, depending on a selected warming control configuration indicated by the configuration information 112, as discussed above. Generally, the selected warming control configuration can be used to select both (1) which of the thermal point sensors 208-1 to 208-5 are used, and (2) which of the warming heaters 214-1, 504-1, 504-2, 214-2 are used. For example, if the active fluid dispensing region is 402 in Fig. 4, then the selected warming control configuration can specify that warming heaters 214-1 and 504-2 are used, but not warming heaters 504-1 and 214-2.

[0079] Fig. 6 shows an example of fine-grained thermal control that can be provided by the operational characteristic based warming control logic 109 of the device controller 108 according to some examples. As shown in Fig. 6, a fluid dispensing device 602 is divided into multiple zones z01 to z14. Although 14 zones are shown in Fig. 6, it is noted that in other examples, a different number of zones can be employed. Each zone includes a collection of actuators (represented by the letter "A"), a thermal sensor (represented by the letter "S"), and a heater (represented by the letter "H"). Note that a zone can include multiple thermal sensors and/or multiple heaters.

[0080] With fine-grained thermal control, the control of the temperature of each individual zone is based on the locally measured temperature from the local point sensor (this is referred to as "local temperature control" performed individually for each zone). The device controller 108 can activate the heater of a given zone in response to the thermal sensor in the given zone dropping below a specified threshold. This enables the device controller 108 to individually maintain each zone at or above a minimum temperature for the zone. The device controller 108 can control each zone independently of another zone.

[0081] In the example of Fig. 6, zones z01 to z03 are inactive zones (i.e., the fluid dispensing pattern indicated by the input data 120 causes no or little fluid dispensing to occur in zones the z01 to z03), while zones z04-z14 are active zones in which fluidic actuators are activated at relatively higher frequency. As a result, since fluidic actuators in zones z01-z03 are off or little used, zones z01-z03 will have a lower temperature than zones z04-z14.

[0082] In some examples, if the goal is to maintain each zone above a minimum threshold temperature regardless of the fluid dispensing pattern that is used, then the heaters in zones z01-z03 will likely dissipate significant heating energy by performing local temperature control. Activating heaters in zones z01-z03 to maintain the temperature in these zones above the minimum threshold temperature is inefficient because the fluid dispensing pattern is such that zones z01-z03 are inactive. Also, activating heaters in zones z01-z03 may be detrimental to overall performance by adding unwanted heat.

[0083] In accordance with some implementations of the present disclosure, the system controller 110 can determine, based on the fluid dispensing pattern indicated by the input data 120 (Fig. 1), that no activation or very little activation of fluidic actuators is to occur in zones z01-z03, while fluidic actuators are active in zones z04-z14. In such examples, the system controller 110 can provide the configuration information 112 to the device controller 108 to indicate that a warming control configuration is to be applied in which local temperature control is not to be activated in zones z01-z03. As a result, the operational characteristic based warming control

logic 109 in the device controller 108 can perform fine-grained thermal control in which local temperature control in zones of z01-z03 is deactivated, while local temperature control in zones z04-z14 remains active.

[0084] In alternative examples, it may be more efficient to use zone z03 as a transition zone so that the temperature of zone z04 does not fall below the temperature of zones z05-z14. In such alternative examples, a warming control configuration indicated by the configuration information 112 can specify that active zones of z04-z14 are to maintain a temperature above threshold temperature  $T_1$ , while zone z03 is to maintain a temperature above threshold temperature  $T_2$ , where  $T_2 < T_1$ . The warming control configuration can also direct inactive zones z01 and z02 to not perform local temperature control.

[0085] Fig. 7 is a block diagram of a fluid dispensing device 700 according to further examples. The fluid dispensing device 700 includes warming heaters 702 (e.g., the end warming heaters 214-1 and 214-2 shown in Figs. 2-5, and/or the additional warming heaters 504-1 and 504-2 of Fig. 5, and/or heaters in fluidic actuators).

[0086] The fluid dispensing device 700 further includes a controller 704 (e.g., the controller 108 of Fig. 1) to perform various tasks. The tasks of the controller 704 include a warming control configuration indicating information reception task 706 to receive first information based on a first fluid dispensing pattern for the fluid dispensing device 700. The first information indicates a first warming control configuration to apply based on fluid dispensing regions with different operational characteristics corresponding to the first fluid dispensing pattern. The first warming control configuration is selected from different warming control configurations (e.g., 130 in Fig. 1) that correspond to different fluid dispensing patterns having respective different arrangements of fluid dispensing regions with different operational characteristics.

[0087] The tasks of the controller 704 further include a warming heaters control task 708 to control the warming heaters 702 according to the first warming control configuration.

[0088] In some examples, the controller 704 can further receive second information based on a second fluid dispensing pattern for the fluid dispensing device 700, where the second information indicates a second warming control configuration to apply based on fluid dispensing regions with different operational characteristics corresponding to the second fluid dispensing pattern, and where the second warming control configuration is selected from the different warming control configurations and is different from the first warming control configuration. The controller 704 controls the warming heaters 702 according to the second warming control configuration.

[0089] In some examples, the fluid dispensing device 700 includes a collection of thermal sensors to detect temperatures of respective different portions of the fluid dispensing device. The controller 704 selectively controls activation of first and second warming heaters based on measurements of plural thermal sensors of the collection of thermal sensors, where the plural thermal sensors selected according to the first warming control configuration.

[0090] In some examples, the different warming control configurations correspond to use of different subsets of the thermal sensors in the collection of thermal sensors.

[0091] In some examples, the controller selectively controls activation of the first and second warming heaters based on differences between the measurements of the plural thermal sensors.

[0092] In some examples, the plural thermal sensors selected according to the first warming control configuration include thermal sensors in a first fluid dispensing region (e.g., 302 in Fig. 3 or 402 in Fig. 4) with a higher fluid amount corresponding to the first fluid dispensing pattern, and does not include any thermal sensor in a

second fluid dispensing region (that is outside of the first fluid dispensing region) with a lower fluid amount corresponding to the first fluid dispensing pattern.

[0093] In some examples, the fluid dispensing device 700 is divided into a plurality of zones, where each zone of the plurality of zones includes a respective fluidic actuator, a respective warming heater of the warming heaters, and a respective thermal sensor, where the controller 704 controls the warming heaters 702 independently in the plurality of zones responsive to measurements of respective thermal sensors in the plurality of zones, and where the control of the warming heaters 702 independently in the plurality of zones is according to the first warming control configuration.

[0094] Fig. 8 is a block diagram of a system 800 (e.g., the fluid dispensing system 100 of Fig. 1) that includes a support 802 (e.g., the support 114 of Fig. 1) for a fluid dispensing device that includes warming heaters.

[0095] The system 800 includes a controller 804 (e.g., the system controller 110 of Fig. 1) to perform various tasks.

[0096] The tasks of the controller 804 include a fluid dispensing pattern data reception task 806 to receive data (e.g., the input data 120 of Fig. 1) representing a fluid dispensing pattern for the fluid dispensing device.

[0097] The tasks of the controller 804 include a warming control configuration selection task 808 to select, based on the fluid dispensing pattern, a warming control configuration from different warming control configurations that correspond to different fluid dispensing patterns having respective different arrangements of fluid dispensing regions with different operational characteristics.

[0098] The tasks of the controller 804 include a warming control configuration transmission task 810 to transmit the selected warming control configuration to cause control of the warming heaters by the fluid dispensing device according to the selected warming control configuration.

[0099] In some examples, the selected warming control configuration causes control of the warming heaters based on (1) a selection of a subset of thermal sensors of the fluid dispensing pattern for control of the warming heaters (e.g., as shown in Figs. 2-5), or (2) an indication that different zones of the fluid dispensing device are to employ different levels of warming based on control of the warming heaters in the different zones (e.g., as shown in Fig. 6).

[00100] Fig. 9 is a block diagram of a non-transitory machine-readable or computer-readable storage medium 900 storing machine-readable instructions that upon execution cause a controller (e.g., the device controller 108 of Fig 1) to perform various tasks.

[00101] The machine-readable instructions include warming control configuration indicating information reception instructions 902 to receive information based on a fluid dispensing pattern for the fluid dispensing device, the information indicating a first warming control configuration to apply based on an active fluid dispensing region and an inactive fluid dispensing region corresponding to the fluid dispensing pattern. The active fluid dispensing region includes a region in which fluid is to be dispensed by the fluid dispensing device, and the inactive fluid dispensing region includes a region in which fluid is not to be dispensed by the fluid dispensing device. The warming control configuration is selected from different warming control configurations that correspond to different fluid dispensing patterns having respective different arrangements of active and inactive fluid dispensing regions.

[00102] The machine-readable instructions include warming heaters control instructions 904 to control warming heaters of the fluid dispensing device according to the first warming control configuration.

[00103] A hardware processor can include a microprocessor, a core of a multi-core microprocessor, a microcontroller, a programmable integrated circuit, a programmable gate array, or another hardware processing circuit.

[00104] Machine-readable instructions executable on a hardware processor can refer to the instructions executable on a single hardware processor or the instructions executable on multiple hardware processors.

[00105] A hardware processor performing a task can refer to a single hardware processor performing the task or multiple hardware processors performing the task.

[00106] A storage medium (e.g., 900 in Fig. 9) can include any or some combination of the following: a semiconductor memory device such as a dynamic or static random access memory (a DRAM or SRAM), an erasable and programmable read-only memory (EPROM), an electrically erasable and programmable read-only memory (EEPROM) and flash memory or other type of non-volatile memory device; a magnetic disk such as a fixed, floppy and removable disk; another magnetic medium including tape; an optical medium such as a compact disk (CD) or a digital video disk (DVD); or another type of storage device. Note that the instructions discussed above can be provided on one computer-readable or machine-readable storage medium, or alternatively, can be provided on multiple computer-readable or machine-readable storage media distributed in a large system having possibly plural nodes. Such computer-readable or machine-readable storage medium or media is (are) considered to be part of an article (or article of manufacture). An article or article of manufacture can refer to any manufactured single component or multiple components. The storage medium or media can be located either in the machine running the machine-readable instructions, or located at a remote site from which machine-readable instructions can be downloaded over a network for execution.

[00107] In the foregoing description, numerous details are set forth to provide an understanding of the subject disclosed herein. However, implementations may be practiced without some of these details. Other implementations may include modifications and variations from the details discussed above. It is intended that the appended claims cover such modifications and variations.

What is claimed is:

1. A fluid dispensing device comprising:  
warming heaters; and  
a controller to:

receive first information based on a first fluid dispensing pattern for the fluid dispensing device, the first information indicating a first warming control configuration to apply based on fluid dispensing regions with different operational characteristics corresponding to the first fluid dispensing pattern, wherein the first warming control configuration is selected from different warming control configurations that correspond to different fluid dispensing patterns having respective different arrangements of fluid dispensing regions with different operational characteristics, and

control the warming heaters according to the first warming control configuration.

2. The fluid dispensing device of claim 1, wherein the controller is to further:

receive second information based on a second fluid dispensing pattern for the fluid dispensing device, the second information indicating a second warming control configuration to apply based on fluid dispensing regions with different operational characteristics corresponding to the second fluid dispensing pattern, wherein the second warming control configuration is selected from the different warming control configurations and is different from the first warming control configuration, and

control the warming heaters according to the second warming control configuration.

3. The fluid dispensing device of claim 1, wherein the warming heaters comprise a first warming heater at a first end portion of the fluid dispensing device, and a second warming heater at a second end portion of the fluid dispensing device, and wherein the controller is to selectively control activation of the first and second warming heaters according to the first warming control configuration.

4. The fluid dispensing device of claim 3, further comprising:  
a collection of thermal sensors to detect temperatures of respective different portions of the fluid dispensing device,  
wherein the controller is to selectively control activation of the first and second warming heaters based on measurements of plural thermal sensors of the collection of thermal sensors, the plural thermal sensors selected according to the first warming control configuration.
5. The fluid dispensing device of claim 4, wherein the different warming control configurations correspond to use of different subsets of the thermal sensors in the collection of thermal sensors.
6. The fluid dispensing device of claim 4, wherein the controller is to selectively control activation of the first and second warming heaters based on differences between the measurements of the plural thermal sensors.
7. The fluid dispensing device of claim 4, wherein the plural thermal sensors are part of a first subset of the thermal sensors in the collection of thermal sensors, and wherein the controller is to further:  
receive second information based on a second fluid dispensing pattern for the fluid dispensing device, the second information indicating a second warming control configuration to apply based on fluid dispensing regions with different operational characteristics corresponding to the second fluid dispensing pattern, wherein the second warming control configuration is selected from the different warming control configurations and is different from the first warming control configuration, and  
selectively control activation of the first and second warming heaters based on measurements of a second subset of the thermal sensors of the collection of thermal sensors, the second subset being different from the first subset and selected according to the second warming control configuration.

8. The fluid dispensing device of claim 4, wherein the plural thermal sensors selected according to the first warming control configuration comprise thermal sensors in a first fluid dispensing region with a higher fluid amount corresponding to the first fluid dispensing pattern, and does not include any thermal sensor in a second fluid dispensing region with a lower fluid amount corresponding to the first fluid dispensing pattern.

9. The fluid dispensing device of claim 3, wherein the warming heaters comprise:

- the first warming heater at a first location relative to a column of fluidic actuators,

- a third warming heater at a second location spaced apart from the first warming heater along a lengthwise axis of the column of the fluidic actuators, wherein the first and third warming heaters are in the first end portion,

- a fourth warming heater at a third location spaced apart from the third warming heater along the lengthwise axis of the column of the fluidic actuators, and

- the second warming heater at a fourth location spaced apart from the fourth warming heater along the lengthwise axis of the column of the fluidic actuators, wherein the second and fourth warming heaters are in the second end portion.

10. The fluid dispensing device of claim 1, wherein the fluid dispensing device is divided into a plurality of zones, wherein each zone of the plurality of zones includes a respective fluidic actuator, a respective warming heater of the warming heaters, and a respective thermal sensor, wherein the controller is control the warming heaters independently in the plurality of zones responsive to measurements of respective thermal sensors in the plurality of zones, wherein the control of the warming heaters independently in the plurality of zones is according to the first warming control configuration.

11. A system comprising:  
a support for a fluid dispensing device that comprises warming heaters; and  
a controller to:  
receive data representing a fluid dispensing pattern for the fluid dispensing device,  
select, based on the fluid dispensing pattern, a warming control configuration from different warming control configurations that correspond to different fluid dispensing patterns having respective different arrangements of fluid dispensing regions with different operational characteristics, and  
transmit the selected warming control configuration to cause control of the warming heaters by the fluid dispensing device according to the selected warming control configuration.
12. The system of claim 11, wherein the controller is to:  
receive further data representing a further fluid dispensing pattern for the fluid dispensing device,  
select, based on the further fluid dispensing pattern, a further warming control configuration from the different warming control configurations, and  
transmit the further warming control configuration to cause control of the warming heaters by the fluid dispensing device according to the further warming control configuration.
13. The system of claim 11, wherein the selected warming control configuration causes control of the warming heaters based on:  
a selection of a subset of thermal sensors of the fluid dispensing pattern for control of the warming heaters, or  
an indication that different zones of the fluid dispensing device are to employ different levels of warming based on control of the warming heaters in the different zones.

14. A non-transitory machine-readable storage medium comprising instructions that upon execution cause a controller to:

receive information based on a fluid dispensing pattern for a fluid dispensing device, the information indicating a first warming control configuration to apply based on an active fluid dispensing region and an inactive fluid dispensing region corresponding to the fluid dispensing pattern, wherein the active fluid dispensing region comprises a region in which fluid is to be dispensed by the fluid dispensing device, and the inactive fluid dispensing region comprises a region in which fluid is not to be dispensed by the fluid dispensing device, and wherein the first warming control configuration is selected from different warming control configurations that correspond to different fluid dispensing patterns having respective different arrangements of active and inactive fluid dispensing regions, and

control warming heaters of the fluid dispensing device according to the first warming control configuration.

15. The non-transitory machine-readable storage medium of claim 14, wherein the fluid dispensing device is a printhead, and the fluid dispensing pattern comprises a pattern of dispensing of a printing fluid to portions of a target medium.

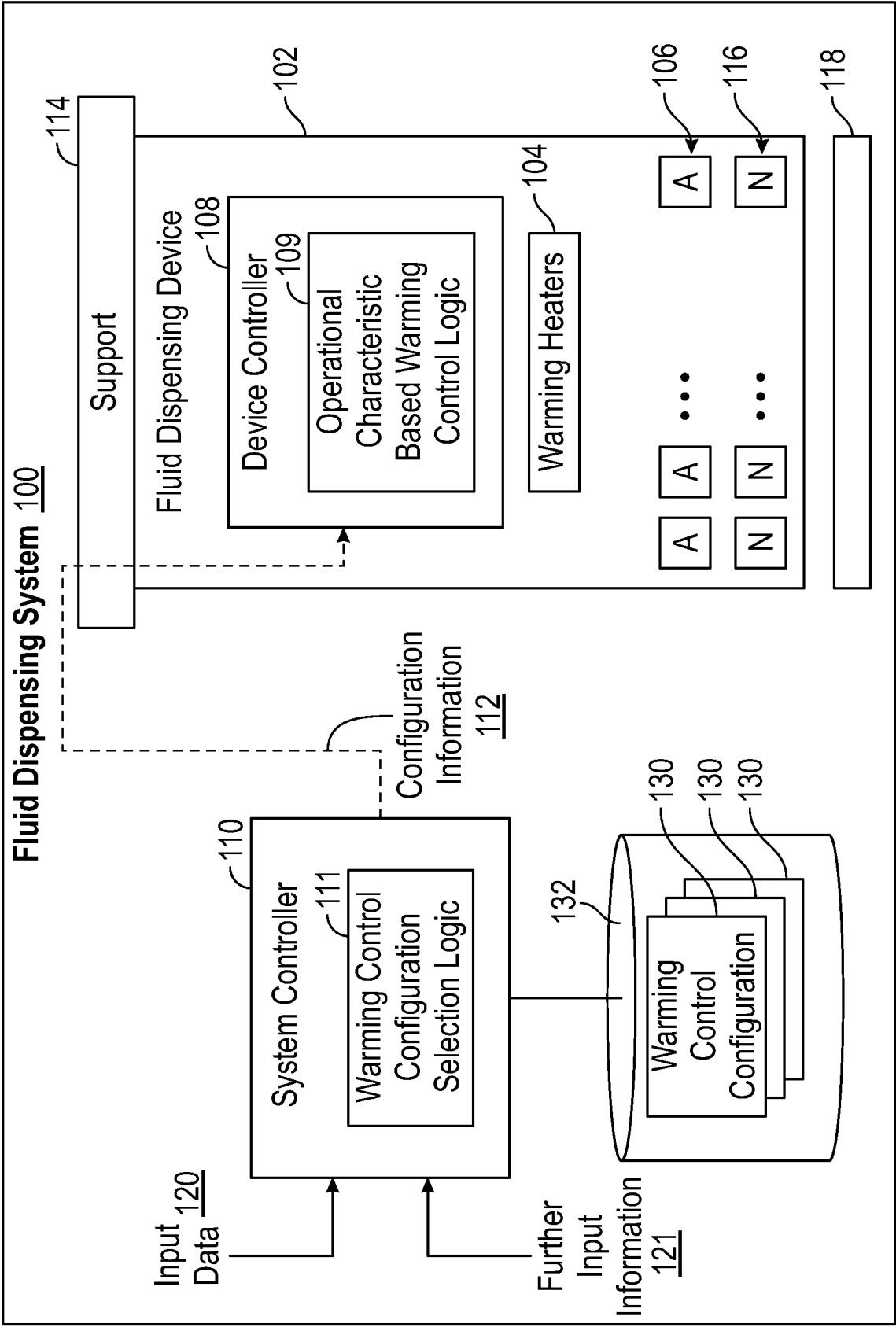
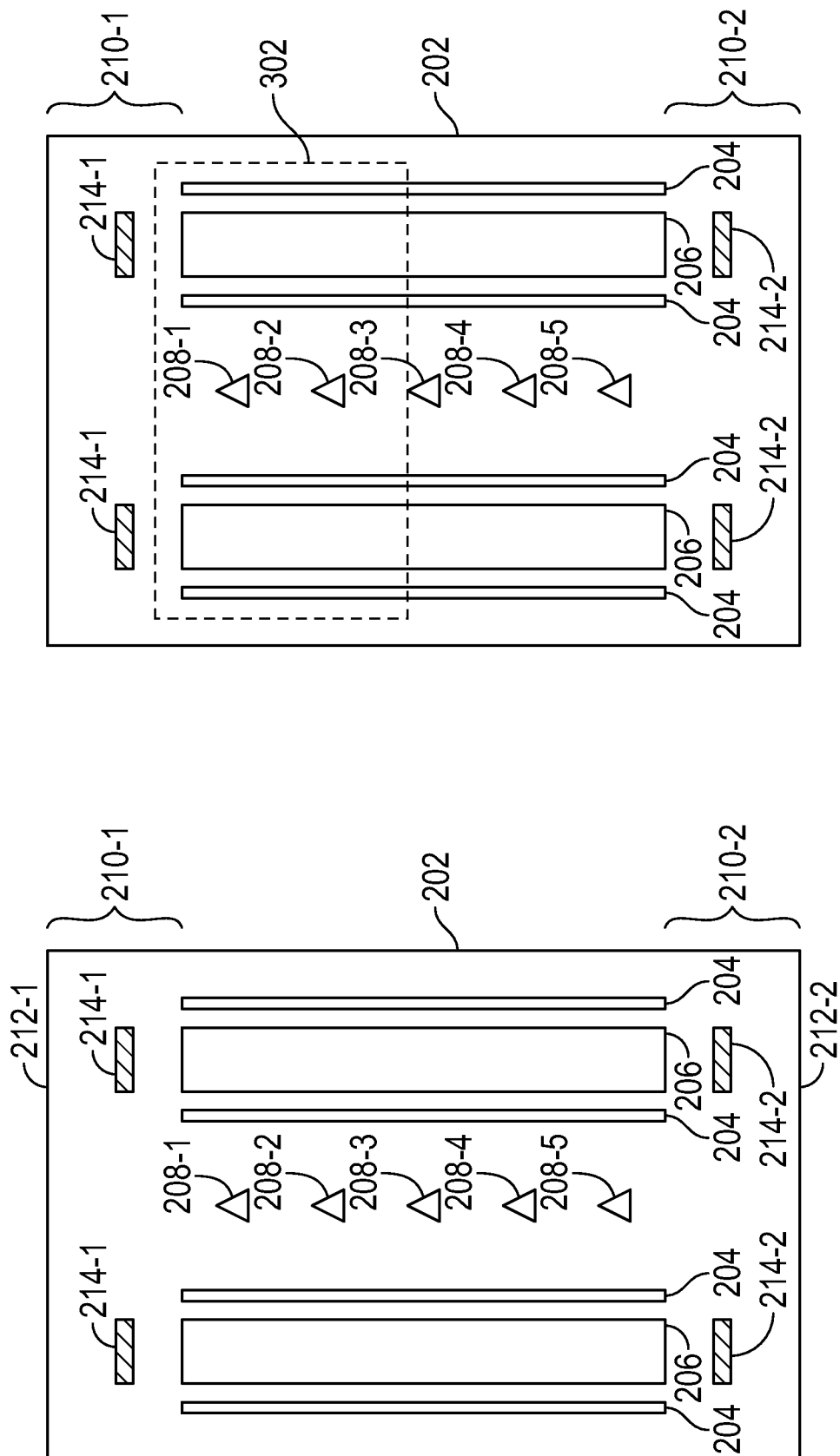


FIG. 1



**FIG. 3**

**FIG. 2**

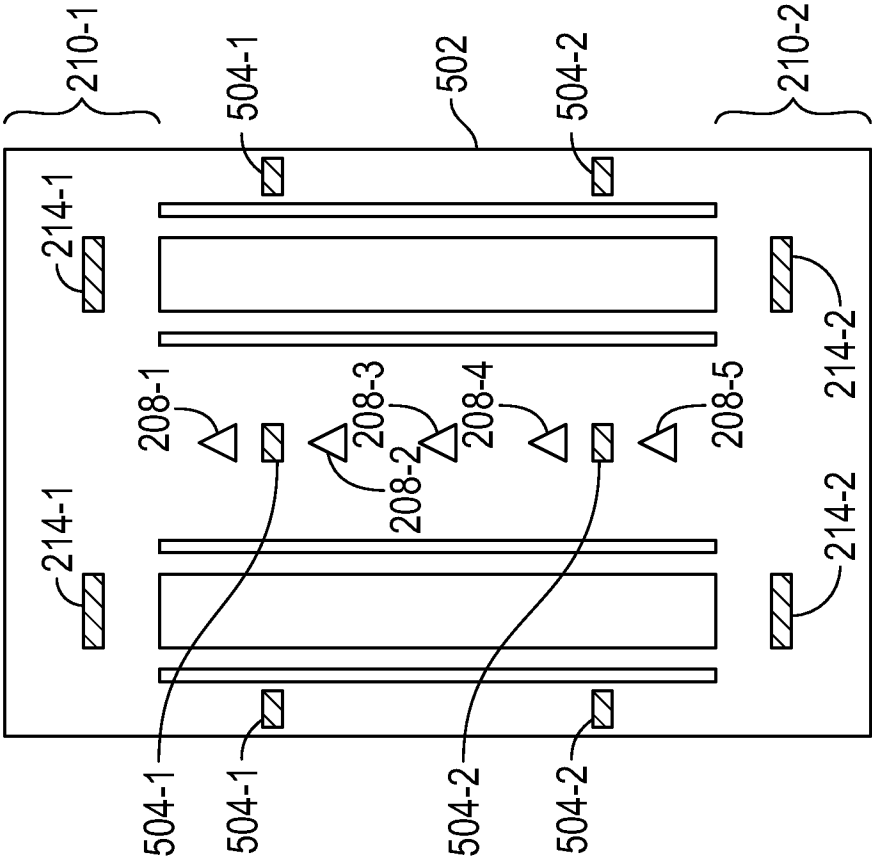


FIG. 5

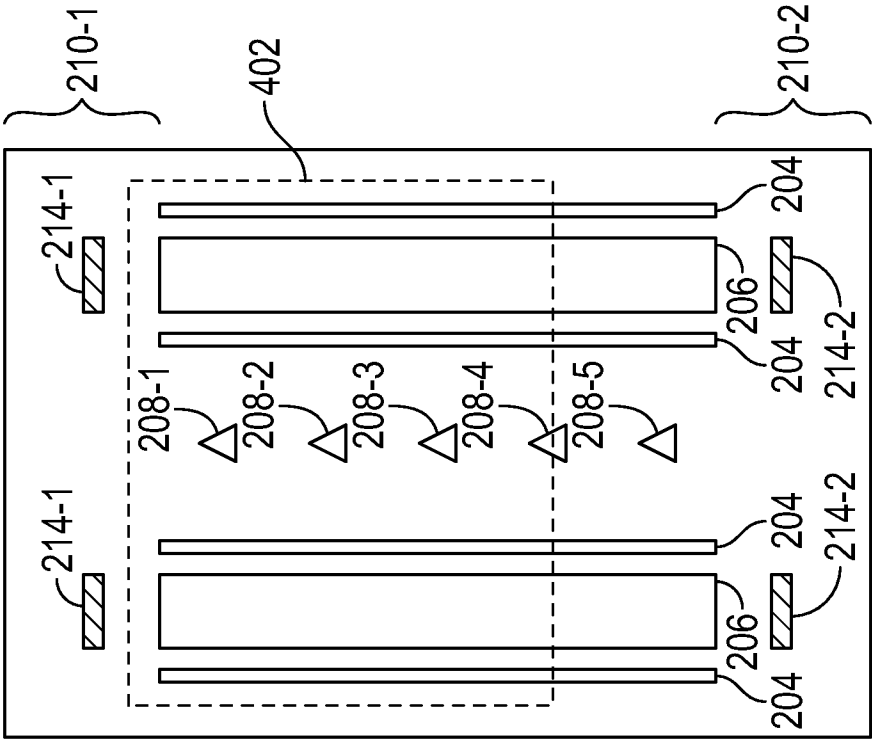


FIG. 4

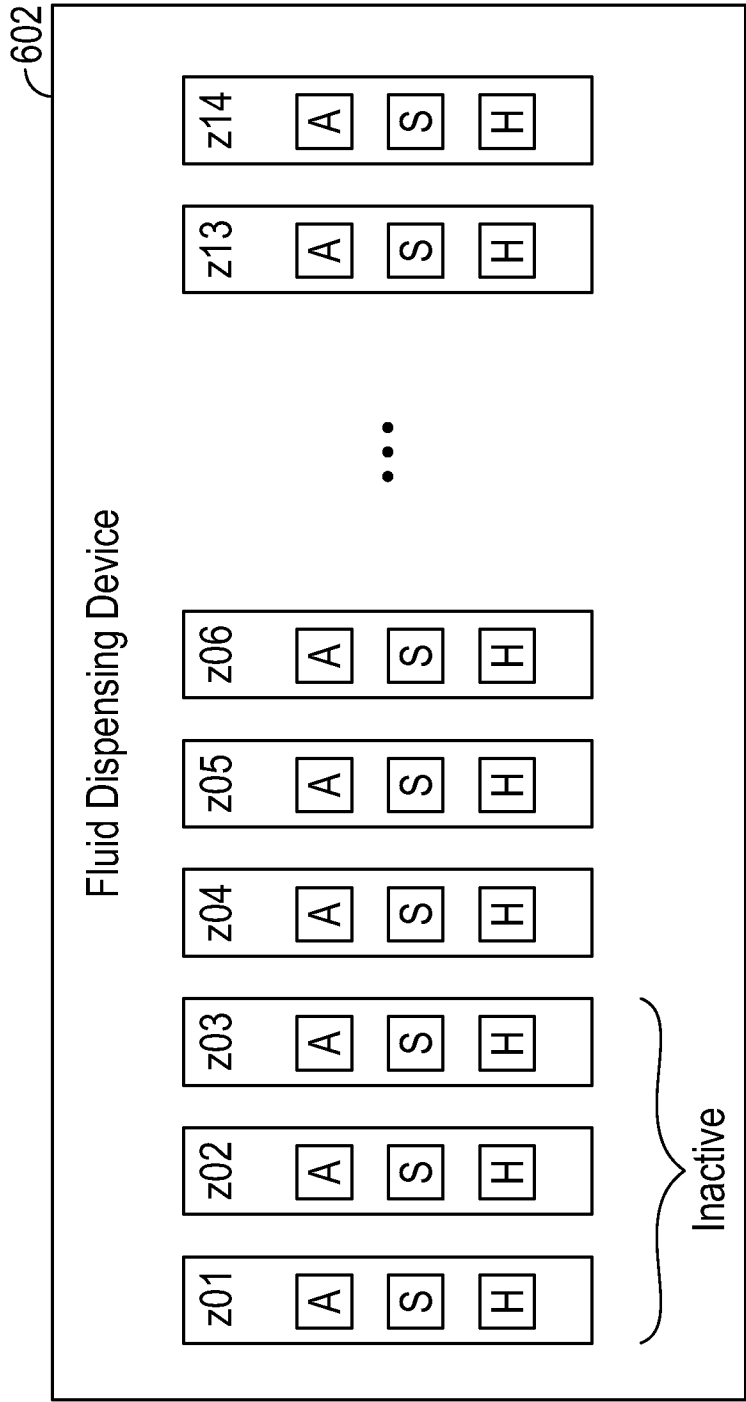


FIG. 6

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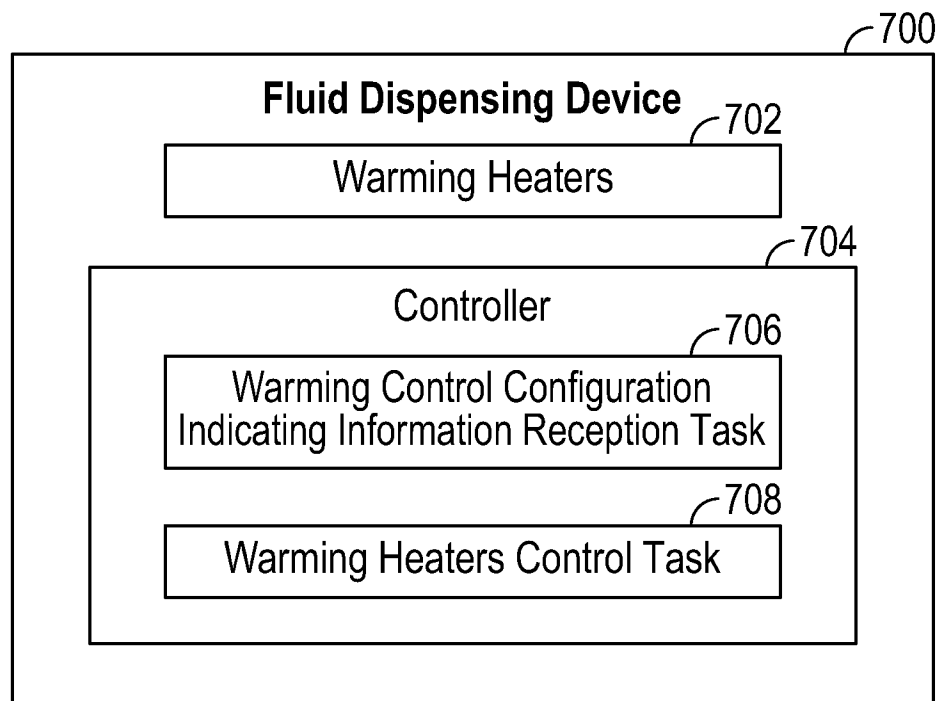


FIG. 7

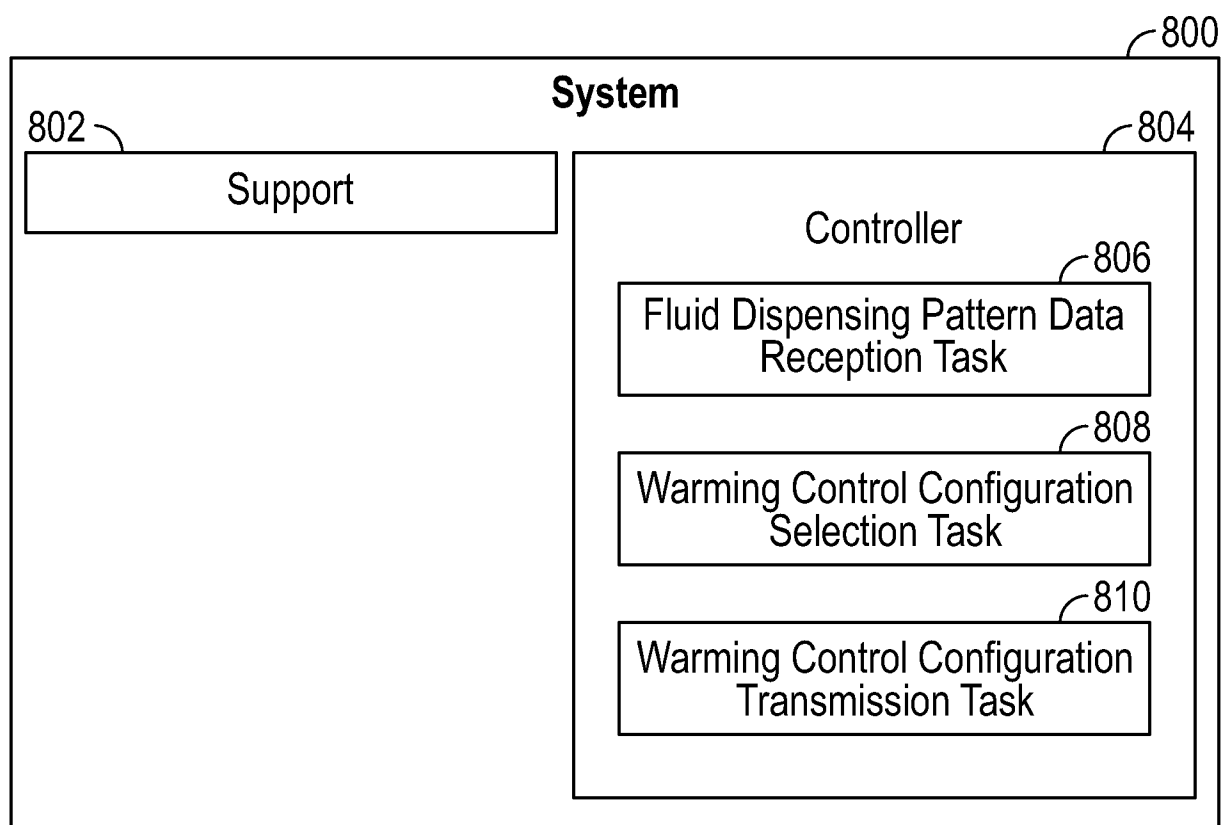


FIG. 8

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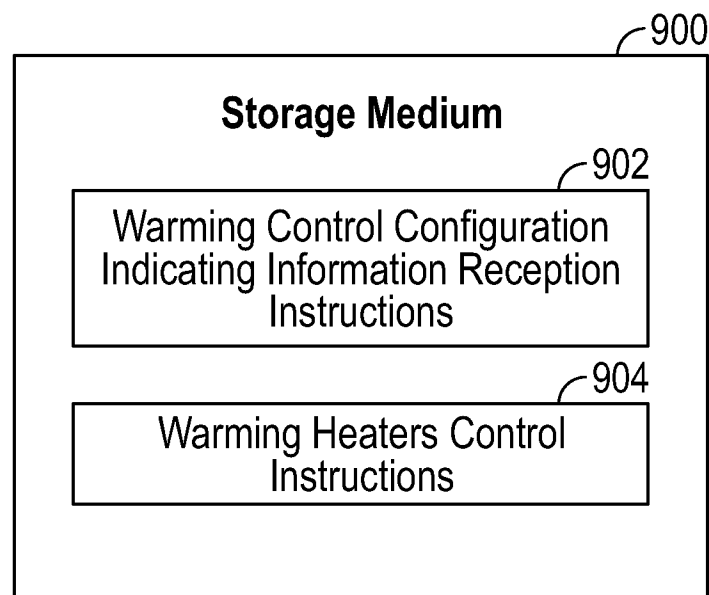


FIG. 9

**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/US 2020/044278

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| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br><div style="text-align: right; padding-right: 50px;"> <b><i>B41J 2/05 (2006.01)</i></b><br/> <b><i>B41J 2/14 (2006.01)</i></b><br/> <b><i>B41J 29/393 (2006.01)</i></b> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>B. FIELDS SEARCHED</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Minimum documentation searched (classification system followed by classification symbols)<br><div style="text-align: center; padding-top: 10px;">                     B41J 2/00-2/17, 2/05, 2/14, 29/393                 </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)<br><div style="text-align: center; padding-top: 10px;">                     PatSearch (RUPTO Internal), USPTO, PAJ, Espacenet, Information Retrieval System of FIPS, EAPATIS                 </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| X<br>Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | US 2005/0088474 A1 (RONALD A. JUVE et al) 28.04.2005, paragraphs [0009], [0012],[0014], [0019], fig.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1-2, 11-12, 14-15<br>3-10, 13                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| <div style="display: flex; justify-content: space-between;"> <span><input type="checkbox"/> Further documents are listed in the continuation of Box C.</span> <span><input type="checkbox"/> See patent family annex.</span> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>* Special categories of cited documents:</p> <p>“A” document defining the general state of the art which is not considered to be of particular relevance</p> <p>“D” document cited by the applicant in the international application</p> <p>“E” earlier document but published on or after the international filing date</p> <p>“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>“O” document referring to an oral disclosure, use, exhibition or other means</p> <p>“P” document published prior to the international filing date but later than the priority date claimed</p> </td> <td style="width: 50%; vertical-align: top;"> <p>“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>“&amp;” document member of the same patent family</p> </td> </tr> </table> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                  | <p>* Special categories of cited documents:</p> <p>“A” document defining the general state of the art which is not considered to be of particular relevance</p> <p>“D” document cited by the applicant in the international application</p> <p>“E” earlier document but published on or after the international filing date</p> <p>“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>“O” document referring to an oral disclosure, use, exhibition or other means</p> <p>“P” document published prior to the international filing date but later than the priority date claimed</p> | <p>“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>“&amp;” document member of the same patent family</p> |
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| Date of the actual completion of the international search<br><div style="text-align: center; padding-top: 10px;">                     26 February 2021 (26.02.2021)                 </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Date of mailing of the international search report<br><div style="text-align: center; padding-top: 10px;">                     11 March 2021 (11.03.2021)                 </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Name and mailing address of the ISA/RU:<br>Federal Institute of Industrial Property,<br>Berezhkovskaya nab., 30-1, Moscow, G-59,<br>GSP-3, Russia, 125993<br>Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Authorized officer<br><div style="text-align: center; padding-top: 10px;">                     E. Kubasova                 </div> Telephone No. (495) 531 64 81                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |